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(54) RADIO PACKET COMMUNICATION METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a radio packet communication method with which the

throughput of entire channel can be prevented from being lowered in a TDMA- TDD radio communication system.

SOLUTION: At the slot of down channel 3-1, the number of slot transmissible due to random access namely, idle slot information 3-8 is periodically reported and at the time point when a transmission packet is generated, a radio packet terminal receives this idle slot information 3-8, selects any slot out of accessible up slots at random and performs random access through this slot. As a result, up access load is prevented from being concentrated to any specified slot by the configuration of TDD like the case of performing random access immediately at the time point of packet generation, and can be uniformly distributed.

CLAIMS

[Claim(s)]

[Claim 1]Between a base transceiver station and two or more radio packet terminals of this base transceiver station subordinate, Perform wireless packet communication using common packet channels, and said packet channels are slot-ized, A going-down slot which takes a frame structure which summarizes two or more continuous slots and is made into one frame, and transmits a packet to said radio packet terminal from said base transceiver station further, Within said frame, by time sharing, a going-up slot which transmits a packet to said base transceiver station applies 1 wave replying method by which multiplex is carried out, and it from said radio packet terminal said radio packet terminal, Perform random access by said going-up slot, and a packet in a radio packet communication method which transmits said base transceiver station, Report empty slot information which directs said going-up slot usable to packet communication with a slot getting down for every slot or every constant period, and said radio packet terminal, Before performing random access, said empty slot information reported is received, Just before transmitting by a going-up slot which chose at random a going-up slot used for this random access, and this chose it after that from going-up slots directed for this empty slot information, said empty slot information is received again, A radio packet communication method characterized by performing transmission of this packet after checking that the going-up slot concerned is in a usable state succeedingly.

[Claim 2]Between a base transceiver station and two or more radio packet terminals of this base transceiver station subordinate, Perform wireless packet communication using common packet channels, and said packet channels are slot-ized, A going-down slot which takes a frame structure which summarizes two or more continuous slots and is made into one frame, and transmits a packet to said radio packet terminal from said base transceiver station further, Within said frame, by time sharing, a going-up slot which transmits a packet to said base transceiver station applies 1 wave replying method by which multiplex is carried out, and it from said radio packet terminal said radio packet terminal, Perform random access by said going-up slot, and a packet in a radio packet communication method which transmits said base transceiver station, In said going-down slot, report said empty slot information for every constant period, and said radio packet terminal, Before performing random access, said empty slot information reported is received, Transmit this packet by a going-up slot which chose at random a going-up slot used for this random access, and this chose it after that from going-up slots directed for this empty slot information, and. When a packet call or a circuit-switched call accompanied by slot allocation newly generates said base transceiver station, A radio packet

communication method characterized by suspending assignment of a slot over packet call concerned or a circuit-switched call until it reports said empty slot information for which change accompanying slot allocation to packet call concerned or a circuit-switched call was made.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the access method at the time of a TDMA-TDD (Time-Division-Multiplexing and 1 wave replying method) radio communications system performing packet communication.

[0002]

[Description of the Prior Art]

**1. Conventional technology 1 (general random access)

In the case where wireless packet communication is performed between a base transceiver station and two or more radio packet terminals, by the usual random access by this radio packet

terminal, when a transmitting packet occurs, access of a up to [a channel] is started instancy. The example of an ICMA (Idle signal Casting Multiple Access) method of operation is shown in drawing 13. It gets down, and in a channel (12-1), when the operating condition of an uphill channel (12-2) is shown by the Busy/Idle signal (12-3), and is in use and Busy is vacant, Idle is reported by this method. A radio packet terminal performs random access by the next going-up channel, when it gets down immediately, a channel receives a control signal (Busy/Idle signal) and the Idle signal is reported, if an uphill packet occurs.

[0003]**2. Conventional technology 2 (TDD ALOHA reserving system)

As shown in drawing 14, it gets down and the frame of this method serves as two or more slots for uphill control (13-2) from the slot for control (13-3), and the slot for data transfer (13-4) used for the packet transfer to both directions. In this method, the radio packet terminal which tries to transmit, First, the base transceiver station which transmitted the reservation signal (13-7) by the slot for uphill control, and received this, In consideration of the existence of other going-up packets and a going-down packet, the slot for data transfer is assigned, it gets down and the quota information on the slot for data transfer (13-8) is notified to each radio packet terminal by the slot for control. The radio packet terminal which has transmitted the reservation signal is the timing shown using this slot allocation information, and transmits an uphill packet (13-9). In this method, it is dynamically controlled about going up / distribution from which it gets down. The radio packet terminal synchronizes with the TDD frame.

Random access (slottedALOHA) is performed by the slot chosen from two or more slots for uphill control at random.

[0004]

[Problem(s) to be Solved by the Invention]By the way, in the conventional radio packet communication method mentioned above, when like going up and going down of TDD are intermingled in one frame and it tries to perform immediate transmission like the conventional technology 1, it gets down and there is a problem that a reservation signal concentrates on the going-up slot immediately after a period. As a result, the collision rate of this slot becomes large and there is a problem that the throughput as the whole will fall.

[0005]On the other hand, in the conventional technology 2, since the slot which can carry out random access goes up and it is assigned fixed within the frame as a slot for control, each radio packet terminal can choose the slot to access at random by synchronizing with a frame. However, to the packet generated from it being necessary to secure the slot for control periodically at

random, channel efficiency becomes small. It is difficult to share the channel with a circuit-switched call or other cells, and to secure the slot for control enough in the system that an empty slot is dynamically assigned according to traffic.

[0006]The purpose of this invention is to provide the allocation method of the packet channels which solved the above point.

[0007]

[Means for Solving the Problem]In order to solve a technical problem described for the foregoing paragraph, in a slot, get down in this invention, report periodically a number of a slot by random access which can be transmitted, and a radio packet terminal, When a transmitting packet occurs, after receiving this reporting signal and choosing a slot at random out of an accessible going-up slot, it is characterized [main] by performing random access by this slot (claim 1). As a result, concentration to a specific slot of going-up access load resulting from composition of TDD is prevented like [it is at the packet generating time and / at the time of performing ** random access], and it becomes possible to make it distribute uniformly. By the way, a radio packet terminal makes a packet delayed when a transmission slot is chosen at random like claim 1 in order to transmit by a selected slot. For this reason, a packet call or a circuit-switched call accompanied by another slot allocation interrupts in this time delay, and there is a possibility that the slot concerned may already have become under use at the time of packet transmission. Therefore, each radio packet terminal needs to check again that it is usable in this slot, just before transmitting by a selected slot. Since this complicates access operation, and it is necessary to get down and it needs to check a signal twice, it may become a factor which lowers success percentage of access in radio especially with low reliability. Then, when a new packet call or a circuit-switched call occurs, a base transceiver station, Until it reports said empty slot information for which change of information content accompanying slot allocation to packet call concerned or a circuit-switched call was made to each radio packet terminal, Assignment of a slot over packet call concerned or a circuit-switched call was suspended (claim 2), and access of a radio packet terminal to a once reported empty slot is guaranteed. Thereby, since a check of empty slot information can also be managed at once, access operation is simplified and it is effective in lowering a rate of access non completion by a transmission error.

[0008]

[Embodiment of the Invention]

**1. Describe a 1st embodiment of this invention with reference to a 1st less than embodiment and a drawing. The example [in / for the system configuration example in this embodiment / to

drawing 1 / this embodiment] of a channel configuration is shown in drawing 2. As shown in drawing 1, the system of this embodiment consists of two or more radio packet terminals (1-2) which exist in the wireless zone (1-4) which a base transceiver station (1-1) and this base transceiver station form, and a line switching terminal (1-3).

[0009]As shown in drawing 2, the radio channel of this embodiment has four-channel TDMA-TDD composition symmetrical with the upper and lower sides, and it bundles one or more slots (2-3) which are not used for the circuit-switched call, and they are used for it as packet channels. In drawing 2, a slot (2-4) is a slot currently used for the circuit-switched call 1. On packet channels, by getting down, although continuous transmission of the channel (2-1) is carried out from a base transceiver station, only when a packet generates an uphill channel (2-2), a signal is transmitted, and packet multiplexing of the signal of two or more radio packet terminals is carried out.

[0010]According to this embodiment, when a circuit-switched call occurs, there is no empty slot and packet channels are set up, one of the slots of packet channels is released, and it assigns a circuit-switched call. By drawing 2, although the slots 0, 1, and 3 were used as packet channels at first, signs that the slot 1 is assigned after that as a communication slot (2-7) of the circuit-switched call 2 which has interrupted, and the remaining slots 0 and 3 serve as packet channels as a result are shown. Thus, in this embodiment, a slot is assigned with the priority to a circuit-switched call, and suppose that the slot which is not used for the line switching is used as packet channels.

[0011]Next, the example of transmission of the going-up packet in this embodiment is shown in drawing 3. Here, the slot 1 is used as a slot for the circuit-switched calls 1 (3-4), and the remaining slots are set up as an object for packets (3-3). Empty slot information (3-8) is given to each going-down slot, and the number of an usable slot is reported to the random access of the present packet (here, the slots 0, 2, and 3 are empty slots).

[0012]The radio packet terminal which send data produced chooses at random the slot which a local station uses from the arbitrary empty slot information which gets down, receives a slot and is reported there. In drawing 3, during the frame F= 1, the radio packet terminal which the going-up packet 1 generated receives the slot 0 of a next frame (frame F= 2), and goes up as a slot to access, the slot 2 is chosen, and random access is performed. Similarly, in the frame F= 4, the frame F= 4 got down, and the radio packet terminal which the going-up packet 2 generated received the slot 3, and has chosen the slot 2 as an access slot. Here, since control delay sufficient in the going-up slot 2 (namely, going-up slot 2 of the frame F= 4) immediately after access slot

selection is not securable, it supposes that transmission is impossible, and it is supposed that it transmits by the slot 2 of a next frame (frame F= 5).

[0013]On the other hand, apart from this, if the circuit-switched call 2 occurs during the frame F= 4, a base transceiver station will be assigned to the circuit-switched call 2 by using the up-and-down slot 2 after the frame F= 5 as the slot for the circuit-switched calls 2 (3-7). thereby -- the empty slot information on each going-down slot reports (0, 3) for (0, 2, 3) as an empty slot to the slot 1 of the frame F= 5 after the slot 2 of the frame. Therefore, during the frame F= 5, get down and the empty slot information on the slot 2 is referred to just before transmission, The radio packet terminal which checked that the slot 2 was deleted from empty slot information interrupts transmission by the slot 2 of the frame F= 5, and tries access again after random delay.

[0014]Thus, in order for the radio packet terminal which the going-up packet 2 generated to interrupt the send action in the slot 2 of the frame F= 5, it is necessary to check again the empty slot information on the going-down slot corresponding to just before transmission. therefore, a radio packet terminal -- ** -- the slot of which ** selection was done in order to obtain an accessible slot number -- on the way -- it is necessary to receive empty slot information twice [a total of] for being unable to come out, and being unable to use it or checking just before transmission

[0015]Next, the example of the base transceiver station by this embodiment and a radio packet terminal of operation is explained. The operation flow of the radio packet terminal in this embodiment is shown in drawing 4. The empty slot information which the radio packet terminal which the transmitting packet generated gets down first, and is reported by the slot is received (Step 6-2). When there is an accessible empty slot here, (Step 6-3) and the going-up slot which a local station uses for access from the inside are chosen at random (Step 6-4). Then, empty slot information is again checked to the selected slot just before waiting (Step 6-5) and transmission (Step 6-6), the case where the succeedingly selected transmission slot is idle status -- transmission of a packet -- carrying out (Step 6-8) -- when already occupied by other communications, it returns to Step 6-3 again, and selection of a slot is redone.

[0016]Next, the operation flow of the base transceiver station in this embodiment is shown in drawing 5. When it gets down from a base transceiver station, the slot has always reported empty slot information (Step 7-2) and a circuit-switched call occurs (Step 7-3), It judges whether the slot currently assigned to packets exists (Step 7-6), and it becomes call loss, when all are assigned to the line switching and an assignable slot does not exist (Step 7-7). On the other hand, when the slot for packets which can be assigned to a line switching exists, one of them is diverted

to line switchings. after choosing the slot diverted to some other purpose (Step 7-8), the slot for packets concerned is released (Step 7-9), the slot is assigned to a circuit-switched call (Step 7-11), simultaneously empty slot information is changed into it (Step 7-10). Contrary to this, when a circuit-switched call is completed (Step 7-4), the slot which was being used for the starting communication is diverted to packet communication (Step 7-5), and empty slot information is changed (Step 7-10).

[0017]**2. Describe a 2nd embodiment, next a 2nd embodiment of this invention. The system configuration example and the example of a channel configuration in this embodiment are the same as a 1st embodiment (refer to drawing 1 and drawing 2). The example of transmission of the going-up packet in this embodiment is shown in drawing 6. Here, the slot 1 is used as a slot for the circuit-switched calls 1 (4-4) like drawing 3. Empty slot information (4-8) is reported by only the slot 0 of each frame, and each radio packet terminal has always received this slot.

[0018]After the frame F= 2 gets down and the radio packet terminal which was gone up during the frame F= 1 and the packet 1 generated acquires empty slot information from the slot 0, it is performing random access with the frame F= 2 by choosing the going-up slot 2. After the next frame F= 5 gets down and the radio packet terminal which similarly was gone up during the frame F= 4 and the packet 2 generated acquires empty slot information from the slot 0, it is performing random access by the going-up slot 2 of the frame F= 5.

[0019]By the way, simultaneously with generating of the going-up packet 2, the circuit-switched call 2 has occurred in the frame F= 4. In such a case, although slot allocation was preferentially performed to this circuit-switched call 2 at a 1st embodiment with the frame (frame F= 5) immediately after circuit-switched call 2 generating, assignment with the frame (frame F= 5) immediately after generating is suspended in this embodiment. This is because it becomes after the slot F= 6 that the empty slot information in consideration of this slot allocation can be reported. Therefore, with the frame F= 6, it got down and the going-up slot 0 is deleted from empty slot information in the empty slot information on the slot 0 at the same time it uses the slot 0 as the slot for the circuit-switched calls 2 (4-7). Thereby, in this embodiment, if it is in the same frame, access to the slot directed for empty slot information will be guaranteed, and a radio packet terminal gets down before transmission, and should just receive a slot once.

[0020]The operation flow of the radio packet terminal in this embodiment is shown in drawing 7. The differences with a 1st embodiment (drawing 4) are that the judgment (Step 8-2) for choosing the slot 0 it is reported that empty slot information is was added, and that reconfirmation (step 6-6,6-of drawing 4 7) of the empty slot in front of transmission is deleted.

[0021]The operation flow of the base transceiver station in this embodiment is shown in drawing 8. The main differences with a 1st embodiment (drawing 5) Empty slot information information (Step 9-3), Release (Step 9-5) of the slot for packets for assigning a circuit-switched call and the assignment (Step 9-6) to a circuit-switched call are the points performed considering the slot 0 as an opportunity (Step 9-2). Thereby, the slot allocation to the circuit-switched call received to timing other than slot 0 is suspended until the empty slot information for which change of information content accompanying the slot allocation to the call concerned was made is reported.

[0022]As mentioned above, although the embodiment of this invention has been explained in full detail with reference to drawings, concrete composition is not restricted to this embodiment, and even if there are change etc. of a design of the range which does not deviate from the gist of this invention, it is included in this invention.

[0023]

[Example]Next, the concrete example of an embodiment mentioned above is described. In this example, the system configuration which excluded the line switching terminal (1-3) from drawing 1 is used. Although the circuit-switched call was assumed in the embodiment mentioned above as communication which interrupts, the case where the packet signal itself interrupts is considered by this example. A packet shall be transmitted in this example, using two or more slots continuously. Random access is performed only by a top slot and a base transceiver station decides to assign the slot used for transmission based on the information on the packet of the head received by random access to following data.

[0024]The example of transmission of the going-up packet in this example is shown in drawing 9. Here, the slot 3 is used as a slot for the circuit-switched calls 1 (5-4). The going-up packet 1 generated with the frame F= 1 transmits top data by the going-up slot 2 of the frame F= 2 with reference to the empty slot information on the slot 0 of the frame F= 2 (5-5).

[0025]On the other hand, a base transceiver station performs the notice of quota by the slot 2 of the frame F= 3. In this notice of quota, the slot number (0, 1, 2) used for packet transmission is shown, and a radio packet terminal transmits a packet, using this slot continuously. However, since empty slot information (0, 1, 2) is already reported in the slot 0 of the same frame (frame F= 3), the succession data of the packet 1 is assigned to the slot after the frame F= 4 here.

[0026]Since empty slot information (0, 1, 2) was reported in the slot 0 of the frame F= 3 at this time as mentioned above, in this frame F= 3, the new packet 2 should occur, those initial data should go up, and it should be transmitted by the slot 0. In this case, a base transceiver station assigns this succession data from the slot (slot 1 of the frame F= 5) immediately after the end of

transmission of the packet 1 for the succession data transfer of the packet 2. Simultaneously, empty slot information is updated according to the quota situation of a slot after the frame F= 4. (-) shows here that an usable slot does not exist. Although this example is a case where a 2nd embodiment is taken into consideration, realizing only using a 1st embodiment is also possible.

[0027]The operation flow of the radio packet terminal in this example is shown in drawing 10. The difference with a 2nd embodiment (drawing 7) is divided into initial data and succession data, and packet transmission a radio packet terminal, It is a point which receives the quota signal from a base transceiver station after transmitting initial data (Step 10-7) (Step 10-8), uses continuously one or two or more slots which are directed there, and transmits succession data (Step 10-11). Here, when initial data are not correctly received by collision etc. in a base transceiver station, it redoes from empty slot information reception (Step 10-3) again after random delay (Step 10-9).

[0028]The operation flow of the base transceiver station in this example is shown in drawing 11. Here, the flow about assignment of a line switching is excluded. the going-up slot used for transmission of a succession packet when a base transceiver station performs empty slot information information by the slot 0 (Step 11-3) and initial data are received by the going-up slot for packets (Step 11-4) -- one or two or more percent person -- it guesses. When it already goes up to another packet and the slot is being assigned, it is necessary to make a succession packet transmit immediately after completing transmission of this packet here. In order to perform this, it is effective to perform scheduling of calculating the timing which specifies the length of the succession packet in initial data and to which it is made to transmit for every packet in a base transceiver station based on this information for example. In this example, a base transceiver station performs this scheduling (Step 11-5), and transmits the quota signal which specifies transmit timing (Step 11-6). Then, empty slot information is changed based on the result by which scheduling was carried out (Step 11-7). Also when all transmission of the packet under transmission is completed (Step 11-8), after changing empty slot information (Step 11-7), it returns to Step 11-2.

[0029]The theoretical calculation result at the time of applying the throughput of the packet by this invention to four-channel TDMA-TDD is shown in drawing 12. the case where this invention is used as shown in this figure -- except for an overloaded state -- a throughput is mostly improved over the whole region. Since there is no necessity of securing the slot for random access periodically and a base transceiver station directs the slot for access dynamically according to the operating condition of a slot, channel efficiency is high, and realization is easy even when the

slot is being shared with a circuit-switched call or other cells.

[0030]

[Effect of the Invention]In this invention, since it can prevent random access concentrating on the specific slot depending on the composition of TDD, there is an effect which prevents the throughput fall of the whole channel. Even when two or more slot accessing method which is this invention is used in this invention, Since what is necessary is to receive only a slot specific at the time of access and the check of empty slot information can also be managed at once, a radio packet terminal simplifies access operation and is effective in lowering the rate of access non completion by a transmission error.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is an explanatory view showing the system configuration example in a 1st embodiment and a 2nd embodiment.

[Drawing 2]It is an explanatory view showing the example of a channel configuration in a 1st embodiment and a 2nd embodiment.

[Drawing 3]It is an explanatory view showing the example of transmission of the packet in a 1st embodiment.

[Drawing 4]It is a flow chart which shows the example of the radio packet terminal in a 1st embodiment of operation.

[Drawing 5]It is a flow chart which shows the example of the base transceiver station in a 1st embodiment of operation.

[Drawing 6]It is an explanatory view showing the example of packet transfer in a 2nd embodiment.

[Drawing 7]It is a flow chart which shows the example of the radio packet terminal in a 2nd embodiment of operation.

[Drawing 8]It is a flow chart which shows the example of the base transceiver station in a 2nd embodiment of operation.

[Drawing 9]It is an explanatory view showing the example of transmission of the packet in an example.

[Drawing 10]It is a flow chart which shows the example of the radio packet terminal in an example of operation.

[Drawing 11]It is a flow chart which shows the example of the base transceiver station in an example of operation.

[Drawing 12]It is a graph which shows the improvement effect of the throughput by this invention.

[Drawing 13]It is an explanatory view showing the example of an ICMA method of operation.

[Drawing 14]It is an explanatory view showing the example of a TDD ALOHA reserving system of operation.

[Description of Notations]

1-1 .... A base transceiver station and 1-2 .... A radio packet terminal, 1-3 .... Line switching terminal, 1-4 .... Wireless zone and 2-1,3-1, 4-1,5-1 .... Get down and Channel, 2-2,3-2, 4-2,5-2 .... Uphill channel and 2-3,3-3, 4-3,5-3 .... The slot for packets, 2-4,3-4, 4-4,5-4 .... Slot for circuit-switched calls 1, and 2-7,3-7, 4-7 .... Slot for circuit-switched calls 2, and 3-8,4-8, 5-5 .... Empty slot information